Journal of Advances in Sports and Physical Education
Abbreviated key title: J. Adv. Sport. Phys. Edu.
A Publication by "Scholars Middle East Publishers"
Dubai, United Arab Emirates

ISSN: 2616-8642 (Print)
ISSN: 2617-3905 (Online)

Evaluation of Nutritional Status of Emaswati Adolescent Swimmers

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Original Research Article

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Article History
Received: 11.06.2018
Accepted: 19.06.2018
Published: 30.06.2018

Abstract: This study aims at examining the dietary intake status of adolescent swimmers. It also compares nutrient intake against the recommended dietary allowances and its associated implications on athlete's health. A total of 65 subjects aged between 11 to 18 years was purposively selected; 35 swimmers and 30 non-swimmers. A structured Food Frequency Questionnaire was used to collect data. Correlations between continuous variables, association between BMI of swimmers and non-swimmers were calculated using ANOVA. The χ^2 test was used to compare the nutrient intake with the RDA of control and experimental group. Swimmers were taller, heavier and had higher waist hip ratio to a non-swimmers. The experimental and control groups reported a significant BMI and MAC. Females in two groups consumed meat protein than their male counterparts despite that the groups had many non-vegans. Although not statistically significant, men's consumption of food stuffs was higher than women; with χ^2 reflecting 3.4897 and 6.4371 respectively at 5%. Comparing MAR and NAR from swimmers and non-swimmers, nutritional intake in both swimmers and swimmers were seen to be inadequate in calcium (93%; 97%), riboflavin (91.7%; 92.6%), zinc (71%; 78.5%), and absorbic acid (94.2%; 95.7%) whereas intake of iron (0.4%; 1.1%) and protein (8.3%; 12.2%) was found adequate except for few swimmers. The means for groups were 0.71 and 0.75 respectively indicating that one or more nutrients were lower than the RDA. Despite that most energy intakes from the subjects were higher than RDA, mean of male and female swimmers on total fibre and fat were below the recommended daily allowances though significantly statistical at 5% level as 2.2645 and 2.1732 respectively. Adolescents showed that they were not consuming less water compared to other drinks of water even after training sessions. A healthy diet throughout is important to provide nutrients that support optimal physical growth and cognitive development. Adolescents are advised to take a balanced diet with food items which meet their recommended daily micro-nutrients intake.

Keywords: Nutritional intake, control and experimental groups, recommended dietary intake, physical activity.

INTRODUCTION

Physical activity exercise and good nutrition play a pivotal role in maintaining good health. Researchers and other health professionals in the 21st century have greatly developed concern about the African children and adolescents' quality of daily diets [1, 14]. In recent years, several national and international initiatives designed to promote healthy eating have identified the importance of young people's dietary choices for both short and long term health of the population [2, 3]. The understanding of dietary behaviour patterns and lifestyle of both children and adults is an essential step in monitoring and ensuring good health. Food choice has several implications on one's well-being such as obesity and overweight which contributes to increased blood pressure from infancy though adolescents [1, 4, 5, 6, 14]. Therefore, there is need in constructing an effective intervention programme to prevent diet-related diseases.

The most dynamic phase of human life is the development from of adolescent and adulthood. Adolescent stage of development is chiefly characterised by remarkable physical, cognitive, social, and emotional changes. Responding to these changes, the adolescent start to fight for independence, identity searching, pressure for peer acceptance and become greatly concerned with own physical body changes. Rapid physical growth calls for high demand for energy and nutrition. Adolescents need active lifestyle despite

that it can negatively affect their eating behaviours and nutrition status. This paper focuses on early and mild adolescence ages, thus 11- 18 years, which ranges within the World Health Organization [15] definition of young people. These ages have pubertal and cognitive changes is a time of increased independence, self-recognition and experimentation especially on food and beverage consumption.

Despite that some parents/guardians and boarding school authorities may have an informed discussion on food purchase for these adolescents, they have little control over a wide range of poor food and beverages diets they take during their absence [1,7,11]. Infants and adolescents are easily influenced by their peers and television (TV) advertisements [12]. Socio-economic conditions of the family has great influence on adolescents' food habits, meal patterns, physical activity, alcohol, beverage and smoking habits [13,14]. Swaziland has scarce literature to qualitatively examine adolescents' eating habits.

Adequate and good nutrient intake during adolescence is critical to cover the nutritional deficits suffered during childhood required to meet the demands of physical activity [21]. An adolescent swimmer needs specific nutrition to maintain normal growth, cognitive development, physiological maturation and support optimum athletic performance during training, competition and post exercise. Following the trend at the 2012 London and 2016 Rio Olympics adolescent swimmers are subjected to high volume and intense training programs, high level competitions [28] expecting elite performance corresponding to maintaining good health standard. Inadequate energy consumption can contribute to poor athletic performance, physical conditioning and recovery. It is crucial that adolescent swimmer's food choices need to be closely monitored and investigated. Therefore, this study aimed at examining the dietary intake status of the adolescent swimmers and compares the nutrient intake with the recommended dietary allowances (RDA) and its associated implications on their health.

METHODOLOGY

Research design

A cross-sectional study was carried out among regional swimmers who were school children aged between 11 to 18 years. Purposive sampling technique was used. Only those affiliated swimmers (experimental group) from Manzini region's registered swimming clubs competing at National Swimming Championships 2017/18 were selected. Non-swimmers (control group) were screened from the community around the University of Swaziland-Kwaluseni main campus to achieve the objectives of the study. A total of 35 adolescent swimmers were selected; 15 female and 20 male adolescent swimmers. The control group includes 30 non-swimmers; 15 female and 15 male adolescents.

Ethical considerations

The subjects and their parents/guardians were briefed about the purpose of the study and consent was obtained prior to the study. The study was approved by the University of Swaziland sports department before the study was carried out. The participants were asked to fill the demographic section of the data form indicating their class/form, age and gender. Three research assistants with a degree in either Physical Education or Sports Science/management and a specialised training in anthropometric measurements were used for data gathering.

DATA COLLECTION

Data were collected through interview using a validated Food Frequency Questionnaire (FFQ) modified from NHANES Food Questionnaire and 2012 Youth Adolescent Food Frequency Questionnaire to obtain specific information targeted to achieve the objectives of the study. The FFQ included eight food categories (Bread, cereals and grains, Meat, Egg, Fish, Fat rich food, Fruit and Vegetable, Dairy products, sweet food/snack). This was designed to acquire qualitative data regarding the common food consumption trends aiming at evaluating the frequency with which certain food items are consumed during a specific time period [16,18]. The entire frequency variables were coded; never/ less than once per week, 1–3 times per week, 4–6 times per week and daily.

Anthropometric measurements

Body weight (kg) was measured using an electronic scale; Seca 710R weighing scale, calibrated beforehand (capacity: 200kg; precision: 50g), and standing height was measured using a Seca 220R telescopic stadiometer (measuring range: 85- 200cm; precision: 1mm). Subjects were barefooted when both weight and height were recorded. The Body Mass Index (BMI) was calculated as body weight (kg)/height (m^2). Classification of BMI was in according to the World Health Organization (WHO) [15]. Waist and hip circumferences and Mid-Arm Circumference (MAC) were measured with an anthropometric tape measure at the nearest 0.1 cm. Obesity was defined and calculated in relationship to WHR.

Nutrient intake

A 24-hour recall record was used to collect the dietary intake information. The food items recalled were converted into their equivalent weight of raw food ingredients. The overall nutritional content adequacy of the diets through mean adequacy ratio (MAR) was calculated, mean of the nutrient adequacy ratios (NARs) for the intake of energy in kilocalorie and 11 nutrients (carbohydrate, protein, calcium, vitamin, iron,

phosphorus, retinol, thiamin, riboflavin, niacin, ascorbic acid) [17,18]. Nutrient's adequacy was evaluated by a comparison between the intakes and recommended dietary allowances (RDA) from food composition table for use in Africa [19], for those not available in the former, was used to calculate energy and nutrients content [18].

DATA ANALYSIS

This was done using Statistical Package for Social Sciences (SPSS) version 22.0 software, where continuous data were expressed as mean ±SD. Correlations between continuous variables, association between BMI of swimmers and non-swimmers were calculated using ANOVA where a *p-value* < 0.05 was considered statistically significant. The χ^2 test was used to compare the nutrient intake with the RDA of control and experimental group.

RESULTS

Table 1 below shows anthropometric measurements of swimmers in comparison with those of non-swimmers. Height and WHR for both the control and experimental groups are statistically significant.

Table-1: Anthropometric data for study subjects incorporated in nutrition survey

Anthropometric measurements	Swimmers n=35	Non-swimmers n=30	p-value
	M±SD	M±SD	
Age	14.03± 3.4	14.12± 3.0	0.000**
Height	159.1± 7.35	154.3 ±7.23	0.003**
Weight	54.3 ± 6.3	62.7 ±7.3	0.001**
BMI	20.1 ± 1.4	26.2± 2.4	0.64
Mild Arm circumference	240.4±30.6	214.1±40.2	0.07
Waist Hip ratio	0.82±0.05	0.71±0.09	0.001**

******statistically significant at p<0.05

Table 1 above presents mean of anthropometrical variables among swimmers and non-swimmers. Swimmers were taller, heavier and had higher waist hip ratio to non-swimmers (p< 0.05). Both experimental and control groups had BMI and MAC significant at 1% level.

Table-2: Comparison of mean food intake (g/day) of control and experimental groups

Diet intake	Males		Females	
	Swimmers n=20	Non-swimmers n=15	Swimmers n=15	Non-swimmers n=15
Cereals & Grains	3.94 ± 1.89	3.58 ± 2.46	3.76 ± 1.92	3.51 ± 2.07
Meat	3.69 ± 1.65	3.04 ± 2.31	4.14 ± 1.20	3.94 ± 2.01
Vegetables	2.36 ± 2.54	3.01 ± 2.23	2.15 ± 2.31	2.96 ± 2.03
Fish	0.24 ± 0.75	0.19 ± 0.31	0.13 ± 0.52	0.09 ± 0.26
Fruits	2.39 ± 1.88	1.76 ± 1.06	2.16 ± 1.43	1.50 ± 0.98
Sweets	1.80 ± 2.35	1.64 ± 1.79	1.70 ± 2.04	1.32 ± 1.15
χ^2	3.4897		6.4371*	
*Significant at 5% level NS-Not significant				

Table 2 above compares mean daily intakes of food in male and females. Grains and cereals and fruits had been consumed much by swimmers than non-swimmers. Females in both control and experimental groups consumed meat protein than their male counterparts. Vegetables were consumed much by non-swimmers than swimmers. Mean consumption of fish was lower from the subject population. Overally men's mean consumption of food stuffs was higher than women though not statistically significant.

Table-3: Macro and Micro Nutrition mean for Male and Female swimmers

Nutrient	RDA (male, female)	Males (20)	Females (15)	t – value
Energy (Kcal)	3 000;2 200	2 900 ± 461.2	1 949 ± 476.2	0.0196
Protein (g)	52;46	46.06 ± 22.41	44.83 ± 21.17	0.2519
CHO (g)	130	204.95 ± 60.11	180.64 ± 72.54	1.5231
Total Fiber	38;28	22.68 ± 7.12	17.82 ± 6.45	2.2645*
Calcium	1 300	67.23 ± 116.33	45.06 ± 60.32	1.5142
Fat (g)	25 -30	20.37 ± 18.14	34.81 ± 40.28	2.1732*
Iron (mg)	11;15	64.06 ± 41.87	67.01 ± 61.91	0.1684
Vitamin A (µg)	900;700	126.32 ±86.49	117.91 ± 88.56	0.2584
Vitamin C (mg)	75;65	83.66 ± 102.03	93.42 ± 160.95	0.2671
Riboflavin (mg)	1.3;1.0	69.16 ± 31.88	76.04 ± 21.83	0.0287
Niacin (mg)	16;14	54.01 ± 23.64	50.83 ± 20.54	1.541
Zinc (mg)	11;9	94.27 ± 40.32	118. 46 ± 66.91	4.3673**
** Significant at 1% level *Significant at 5% level				

Table 3 presents mean energy, macro and micro nutrients and fiber intakes of the control group (swimmers). Reported energy intakes were higher than RDA in the 35 study participants. Mean of energy, protein and CHO intakes were significantly higher in both men and female subjects, however, their means between gender were not statistically significant. Mean of energy intake reported for both male and female swimmers on total fibre and fat were below the recommended daily allowances. Despite this, their means were significantly statistical at 5% level as 2.2645 and 2.1732 respectively. Comparatively, mean zinc intake between males and females was statistically significant at 1% level.

Table-4: Macro and Micro Nutrition mean for Male and Female non-swimmers

Nutrient	RDA (male,female)	Males (15)	Females (15)	t – value
Energy (Kcal)	3 000;2 200	2 489.11 ± 206.14	1 390.63 ± 294.13	0.0353
Protein (g)	52;46	29.82 ± 31.49	25.52 ± 13.61	0.8624
CHO (g)	130	122.49 ± 62.41	119.67± 50.36	0.40.14
Calcium	1300	17.26 ± 23.51	20.23 ± 20.45	0.4867
Total Fibre	38;28	20.16 ± 5.22	15.45 ± 4.39	0.3652
Fat (g)	25 -30	18.98 ± 21.23	17.29 ± 17.24	0.4593
Iron (mg)	1 300	28.92 ± 17.16	32.65 ± 25.22	0.3785
Vitamin A (µg)	900;700	120.58 ± 75.16	100.05 ± 80.26	0.7354
Vitamin C (mg)	75;65	72.66 ± 80.94	84.42 ± 96.61	0.4227
Riboflavin (mg)	1.3;1.0	56.27 ± 25.19	61.83 ± 18.43	0.3633
Niacin (mg)	16;14	50.44 ± 20.04	45.90 ± 17.72	0.1849
Zinc (mg)	11;9	81.27 ± 36.82	101.27 ± 51.61	4.2460**
** Significant at 1% level *Significant at 5% level				

Table 3 presents mean energy, macro and micro nutrients and fiber intakes of the experimental group (non-swimmers). Mean of energy from protein and CHO intakes were significantly higher in both men and female subjects than RDA in the 30 study participants. Mean of zinc intake between males and females was 4.2460, which was statistically significant at 1% level.

Table-5: Comparison of Mean Adequacy Ratio (MAR) and Nutrition Adequacy Ratios (NAR) from Swimmers and Non-Swimmers

Ratios	Swimmers	Non-Swimmers	% below recommended nutrient intake to RDA	
	M ± SD	M ± SD	Swimmers	Non-swimmers
NAR* Energy	0.78 ± 0.42	0.86 ± 0.34	-	0.8
NAR Protein	1.51 ± 0.84	1.93 ± 0.92	8.3	12.2
NAR Calcium	0.64 ± 0.23	1.56 ± 0.22	93	97
NAR Iron	9.83 ± 6.14	9.82 ± 6.67	0.4	1.1
NAR Riboflavin	0.57 ± 0.21	0.85 ± 0.27	91.7	92.6
NAR Zinc	1.51 ± 0.94	1.42 ± 0.98	71	78.5
NAR Absorbic acid	0.71 ± 0.10	0.72 ± 0.14	94.2	95.7
MAR**	0.71 ± 0.08	0.75 ± 0.13		
*: nutrient adequacy ratio, **: mean adequacy ratio, : recommended dietary allowances				

Table 5 above presents a comparison of MAR and NAR from swimmers and non-swimmers. The nutritional intake in both swimmers and swimmers were seen to be inadequate in calcium (93%; 97%), riboflavin (91.7%; 92.6%), zinc (71%; 78.5%), and absorbic acid (94.2%; 95.7%) whereas intake of iron (0.4%; 1.1%) and protein (8.3%; 12.2%) was found adequate except for few swimmers. The mean MAR for the swimmers and non-swimmers were 0.71 and 0.75 respectively which are less than 1 indicating that one or more nutrients are lower than the recommended dietary allowance.

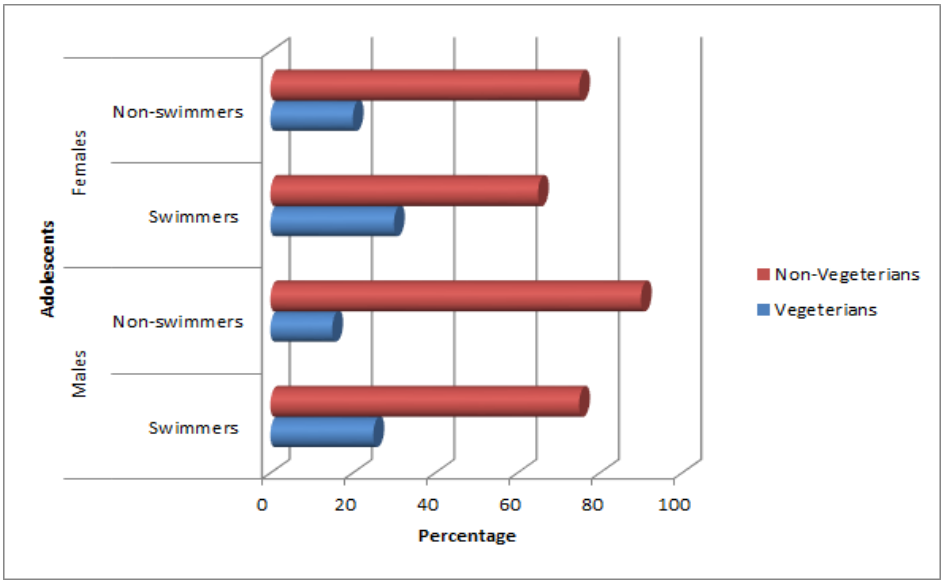

Fig-1: Food habits of Adolescent Males and Females

From figure 1 above, dietary intake and food pattern clearly point out that the most of adolescent non-swimmers and swimmers are non-vegetarians. A remarkable number from the non-swimmers boys and girls are non-vegetarians with a percentage of 90% and 75% respectively, whereas for non-vegetarian swimmers boys are 75% and girls are 60%. From both, the experimental and control groups, vegetarians are found to be of a lesser percentage. For athletes, a vegetarian diet can be a very healthy option. Different reasons for adopting vegetarian diets include cultural and religious beliefs, moral beliefs concerning animal rights, health benefits, and environmental issues however swimmers need to carefully plan their intake to get the protein and minerals they need. Strict vegans may need nutritional supplements to meet their needs for calcium, vitamin B_{12}, and iron [21].

DISCUSSION

This cross-sectional study shows nutritional status and dietary intake for provincial swimmer and non-swimmer adolescents. The current study results show undesirable diets habits were practiced by adolescents according to Dietary Reference Intakes (DRI). They consumed much energy-dense food, saturated fats and insufficient micronutrient intake. Comparatively, swimmers tended to have adequate intake than non-swimmers. Results show that non-

swimmers had a higher BMI than swimmers which may be considered as a great risk to cardiovascular disease due to their lipid profile [1, 4, 17,18]. Literature covering BMI and prevalence of overweight and obesity in southern African countries, urban populations are significantly affected [4,17,21].

Adolescence have intense concern about their appearance, nutrition and gaining of weight [23]. Weight gain in adolescents is often due to the consumption of large portions of food, frequent snacking, and high intake of sugary beverages [24]. To reverse adolescent obesity, a combination of behavioral and environmental changes which includes; food intake, physical activity (PA) and leisure activities is needed [4,24]. There is a strong inverse correlation between the level of physical activity and fitness and obesity; that is the lower level of PA, the lower level of cardiovascular fitness, the greater the risk of obesity development.

Dietary intake of fish by both swimmer and non-swimmer adolescents show a low significant value despite the closeness of Swaziland to Indian Ocean. This was due to culture, religion and moral-specific dietary practices and to some it was merely the affordability of the product. Eating more vegetables and fruits as part of Dietary Approaches to Stop Hypertension (DASH) are associated with reduced risk to cardiovascular diseases [25], however, the majority families consume vegetables not only as a health consciousness measure but also due to socioeconomic factors. For some swimmers who were non-vegans a desire to lose weight was adopted by the use of vegetarian or vegan diet. The vegan diet may inadvertently reduce caloric or protein intakes because animal flesh and dairy products are removed from the diet [23]. Moreso, it can be noted that sodium intake might be lowered due to removal of dairy products, therefore calling the need for salty sweaters adjustments.

In Swaziland tradition and culture, an increased level of body fat is associated with wealth, health, prosperity and beauty in female counterparts despite its negative health impact. While all humans need fat in their diets to provide essential fatty acids, that the body cannot manufacture, the study population's fat intake (saturated fat, animal products) was higher than the acceptable macronutrient distribution range, hence adversely affecting nutrition transition. Fat intake needs to be relative to carbohydrate and protein intakes and many adolescents (swimmers and non-swimmers) consume too much fat and not enough carbohydrate and protein [23,27]. The macro and micro nutrients dietary change patterns may result with the risk of overweight, obesity and other non-communicable disease.

CONCLUSION

The knowledge of Sports nutrition is of paramount importance aspect in maintaining the health and to improve the performance of swimmers. The current study found that BMI and MAC were significant among the swimmers and non-swimmers. The nutrient intake of the adolescents higher than the RDA computed on individual basis pertaining to energy, carbohydrate, protein, cholesterol, fatty acids, iron, vitamin C and Calcium among the swimmers and non-swimmers (boys and girls). A healthy diet throughout puberty and adolescence is important to provide nutrients that support optimal physical growth and cognitive development. Although it is advisable that micro-nutrients should be obtained from food, many adolescents do not reach daily intake recommendations for select micro-nutrients from diet alone. Nutritional intake during adolescents can have long-term life implications.

ACKNOWLEDGEMENT

Great appreciation is passed to the UNISWA sports department and the swimmer parents' assistance to make this study a complete project.

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